Non-primary cortical sources of auditory temporal processing

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Abstract

Auditory information is transmitted to the higher brain centers through the primary and the non-primary auditory pathways. The primary pathway goes from the brainstem, to the midbrain, and then to the thalamus before terminating at the primary auditory cortex. In a parallel pathway, the non-primary pathway initiates at the cochlear nuclei and connects to the reticular formation, a region of the brainstem with interconnected nuclei. These fibers project through reticular formation into the thalamus and then to the association cortices. Despite several studies on the sub-cortical centers of the non-primary pathway, detailed information on the non-primary cortical centers that are responsive to auditory stimuli is lacking. The main aim of this study is to gain insight into cortical sources underlying auditory temporal processing, more specifically, non-primary cortical sources. To accomplish this, the brain sources of auditory steady-state responses (ASSRs) to amplitude modulated acoustic stimuli are reconstructed. This study provides a new insight into the regions of association cortex that are electrophysiologically responsive to acoustic inputs.

In order to reconstruct ASSR sources, we applied independent component analysis (adaptive mixture ICA) with subsequent equivalent dipole modeling to the concatenated EEG data of all subjects (young adults, 20-30 years of age). These data were based on responses to white noise stimuli, amplitude modulated at 4, 20, 40, or 80 Hz. The independent components that exhibited a significant response at the respective modulation frequencies were recognized as ASSR sources.

Our results suggest that the cortical sources underlying auditory temporal processing are not restricted to the primary auditory cortex and other sources in the association cortex are also involved in auditory temporal processing. For the four modulation frequencies, the identified sources, either primary or non-primary, were located in the physiologically and anatomically plausible locations.